

The Resource

for Environmental Education in Missouri

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Photo by Cliff White

Environmental Monitoring

*Taking Field Experiences
to the Next Level*

by Dr. Bob Coulter

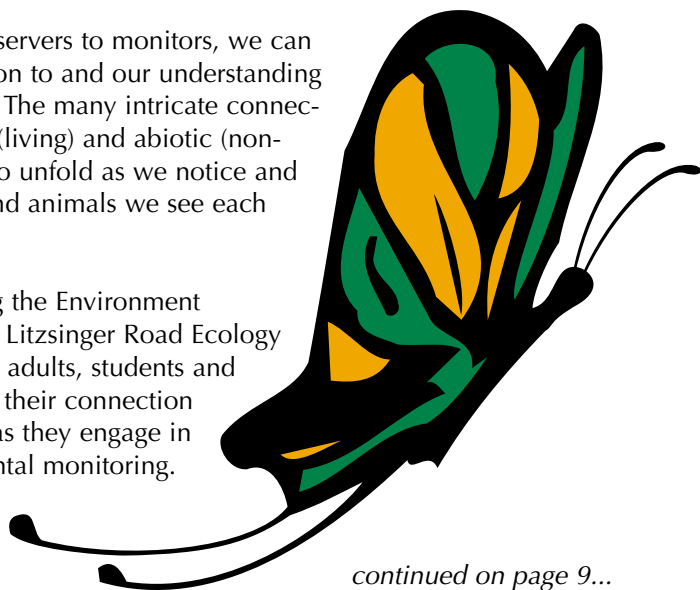
Litzsinger Road Ecology Center of the Missouri Botanical Garden

Readers of *The Resource* share a love of the outdoors. We strive to maintain and nurture our connection with the environment in various ways, such as gardening, taking leisurely walks in the woods or maintaining a bird feeder on the back porch. Often these experiences with the natural world stimulate our curiosity and cause us to pose thought-provoking questions: Why have my tulips emerged on the south side of the house and not the north? Why are the juncos here in the winter and gone in the spring? Did they arrive early this year? When can I expect to see monarch butterflies return to Missouri?

We've moved to a deeper level of awareness when thoughts and questions move from basic observations of species to questions of what can be found, when it can be found, and why there, and not in other places. We've begun to monitor the environment. We now come filled with questions and expectations, seeking to tease out explanations of what we see. A discrepant event, such as a late bloom or an early migration, is the source of a whole line of inquiry that begs to be answered. Has it been an unusually cold spring? Has something changed the local habitat? How can we find out?

As we move from observers to monitors, we can deepen our connection to and our understanding of, the natural world. The many intricate connections between biotic (living) and abiotic (non-living) factors begin to unfold as we notice and record what plants and animals we see each time we are afield.

Through the Mapping the Environment program based at the Litzsinger Road Ecology Center, we have seen adults, students and scout groups grow in their connection to the natural world as they engage in sustained environmental monitoring. For example, each year students and



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What's in it for you?

- ◆ **Citizen Monitoring Projects** pages 2-3, 6
- ◆ **Introduction to GIS** pages 4-5
- ◆ **Conservation Curriculum** pages C1-C8
- ◆ **Project Resources** page 7
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- ◆ **PLUS - SPECIAL PULLOUT POSTER: Birding 101**

An entire issue devoted to
Citizen Monitoring!

The Library

Conservation and Environmental Education Resources

This issue's Library section profiles citizen monitoring projects, websites and other resource materials to help you incorporate environmental monitoring into your educational efforts. The icons indicate whether the item is available primarily in Missouri, nationally or internationally.

AMPHIBIANS



Frogwatch USA

<<http://www.mp2-pwrc.usgs.gov/frogwatch>>

Timeframe: Spring and Summer

An educational, long-term frog and toad monitoring program. Volunteers participate by learning the life histories and the voices of their local frogs and toads, choosing safe and convenient wetlands to monitor (often in backyards or local parks), periodically monitoring sites by listening (frogwatching) three minutes for frogs and toads after dusk and submitting findings via the internet.



North American Amphibian Monitoring Program

<<http://www.mp1-pwrc.usgs.gov/amphibs.html>>

Timeframe: Spring - Fall

Part of a global effort to study and conserve amphibians. "Teachers' Toolbox" page devoted to monitoring programs that can be done by all ages. Includes terrestrial salamander monitoring during the day and frog calling surveys at night.



Amphibians and Reptiles of Missouri

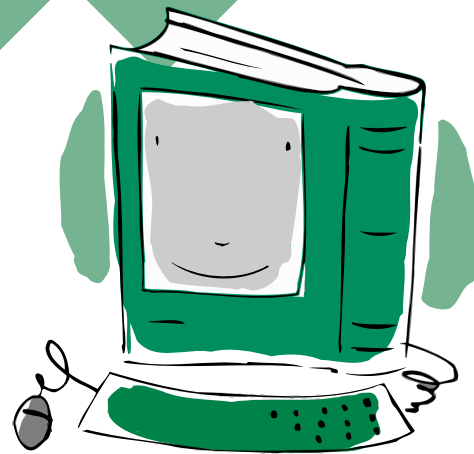
Guide to the habits, habitats, breeding and distribution of 132 reptiles and amphibians found in Missouri. 368 pages.

Revised 2000. Soft cover. \$18.

Toads & Frogs in Missouri Cassette with Poster

Herpetologist Tom R. Johnson has recorded 20 Missouri toad and frog calls for your listening enjoyment. On side one, a narrator introduces various amphibian sounds. Side two features a description of each toad or frog, natural history information and sample breeding calls. A large poster with color photos of toads and frogs accompanies the cassette. \$5.

The preceding publications are available from the Missouri Department of Conservation's Nature Shop, 877.521.8632 (toll free), <www.mdcnatureshop.com>.



CLIMATE & SOIL



Global Learning and Observations to Benefit the Environment (GLOBE) <<http://www.globe.gov>>

Timeframe: Ongoing

Students and teachers from over 9,800 schools in more than 95 countries work with research scientists to learn more about our planet (investigations include atmosphere, hydrology, soil, land cover/biology and seasons). Students make environmental observations at or near their schools and report data through the Internet. Scientists use GLOBE data in their research and provide feedback to the students to enrich their science education.

FORESTRY



Missouri Forestkeepers Network

<<http://www.forestkeepers.org>>

Timeframe: Ongoing

Missouri's comprehensive volunteer forest health monitoring system for rural and urban sites. Gives citizens of all ages the tools and training they need to assess tree health based on crown, foliage, trunk and limbs. Members choose the number of sites and number of times to monitor. These volunteers are the "eyes and ears" on the forest and provide an early warning system about forest health threats such as gypsy moth infestation.

BIRDS



Cornell Lab of Ornithology Citizen Science Portal <<http://birds.cornell.edu/citsci>>

Links to many citizen monitoring sites, including Golden-winged Warbler Atlas Project, Atlas 2000, House Finch Disease Survey, Irruptive Bird Survey, Autumn Hawk Watch, BirdCast and Warbler Watch.



Christmas Bird Count <<http://www.birdsource.org/cbc>>

Timeframe: December 25

More than 45,000 volunteers participate each year in this all-day census of early-winter bird populations. Results are compiled into the longest running database in ornithology, representing one hundred years of unbroken data on trends of early-winter bird populations across the Americas.



Great Backyard Bird Count <<http://birdsource.cornell.edu/gbbc>>

Timeframe: February

The data collected from this weekend count is combined with data from the Christmas Bird Count and Project Feeder Watch to give a more complete picture of winter birds.



Project FeederWatch; Classroom FeederWatch <<http://birds.cornell.edu/pfw>>; <<http://birds.cornell.edu/cfw>>

Timeframe: November - March

Volunteers set up bird feeders, count the birds that visit and then send data to scientists. Classroom FeederWatch extends this idea by offering an interdisciplinary curriculum. Students learn how science and scientists work and, in the process, become scientists themselves.



Project Pigeon Watch <<http://birds.cornell.edu/ppw>>

Timeframe: Ongoing

International research project involving volunteers of all ages and locations in a real scientific endeavor. Participate by counting pigeons and recording courtship behaviors observed in neighborhood pigeon flocks.



Birds at Your Feeder: A Guide to Feeding Habits, Behavior, Distribution and Abundance

Dunn. Summarizes data from thousands of Project FeederWatch participants. Describes 88 common feeder birds, along with sketches, charts, maps and details on attracting specific birds using seed mixes, fruits, nuts and even table scraps. \$29.95. Acorn Naturalists, 17821 East 17th Street, Suite 103, Tustin, CA 92781-2423, 800.422.8886, <<http://acorn-group.com>>.

MIGRATION PATTERNS



Journey North <<http://www.learner.org/jnorth>>

Timeframe: Spring (Fall - Journey South)

The journeys of a dozen migratory species, including monarchs, hummingbirds and orioles, are tracked each spring. Students share their own field observations on events, such as the first tulip bloom, with classrooms across the hemisphere. In addition, students are linked with scientists who provide expertise directly to the classroom. Several migrations are tracked by satellite telemetry, providing live coverage of animals as they migrate.



Monarch Watch <<http://www.monarchwatch.org>>

Timeframe: mid-August through October (tagging)

Network of students, teachers, volunteers and researchers who monitor monarch butterfly populations. The efforts of volunteer taggers enable researchers to obtain sufficient recoveries and observations of the migration to answer the many questions surrounding monarchs. Introduces students to science and lets them contribute to a scientific study.



Monarchs in the Classroom

A K-8 curriculum related to the life cycle and ecology of Monarch butterflies. It is an interdisciplinary, inquiry-based supplement to classroom science instruction. For more information, visit <www.monarchlab.umn.edu>. Send \$18.50 to University of Minnesota, Department of Ecology, 1987 Upper Buford Circle, St. Paul MN 55108. Be sure to specify the grade level (K-2, 3-6 or Middle School).

NATURE MAPPING



Iowa Nature Mapping <<http://www.naturemapping.state.ia.us>>

Nature Mapping in Washington

<<http://www.fish.washington.edu/naturemapping>>

Timeframe: Ongoing

Links natural resource agencies, academia and land planners with local communities primarily through schools. Trains individuals to become aware of natural resources and provides the tools to inventory and monitor resources. Volunteers collect data on wildlife observed. The data are mapped on a GIS system (see pages 4-5).

Geographic Information Systems:

What is a GIS?

In its simplest form, a Geographic Information System is nothing more than layers of information about a particular place. These layers may include roads, streams and civil boundaries which, with a GIS, can be viewed on a computer rather than on paper.

Maps were first created by ancient cartographers to help guide voyagers' journeys. Today, virtually all of us use maps to help us get around. Although there are many types of maps, no single map contains every piece of information or covers the entire earth. Unfortunately, the biggest limitation of maps is that they are static; "what you see is what you get."

In contrast, a GIS enables us to select and examine data of specific interest by employing computers and software. A layer's features, and information about these features, are stored digitally. Users can zoom in or out to look at different areas or certain features.

A GIS, however, is more than just a digital road map. GIS is used by natural resource managers to help manage fish and wildlife resources. The Federal government analyzes Census data using GIS to focus its assistance programs. Teachers use GIS to help their students explore the world.

*by Tony Spicci, GIS Coordinator
Missouri Department of Conservation*

How Can I Use GIS with Students?

A picture is worth a thousand words, and a picture can stimulate a multitude of ideas. That's the value of GIS in a learning environment. Geographic Information Systems are well suited to the mapping and charting of demographic and biological data. Whether collecting your own data or exploring existing data sets, GIS encourages interactive learning through quick visual displays of patterns and trends.

For elementary students, an introduction to GIS should involve simple investigations of the concepts of space. Have students construct and explore maps of their classroom, school building or neighborhood, exploring the concepts of distance, area, density and scale.

Middle school grades can begin to explore the layering capabilities of GIS when investigating interrelated phenomena or changes over time, such as correlation or cause and effect. Examples include: evaluating the effect of road closings in National Parks on Grizzly bear habitat; calculating the loss of forest cover over time; and prioritizing land for preservation of habitat corridors.

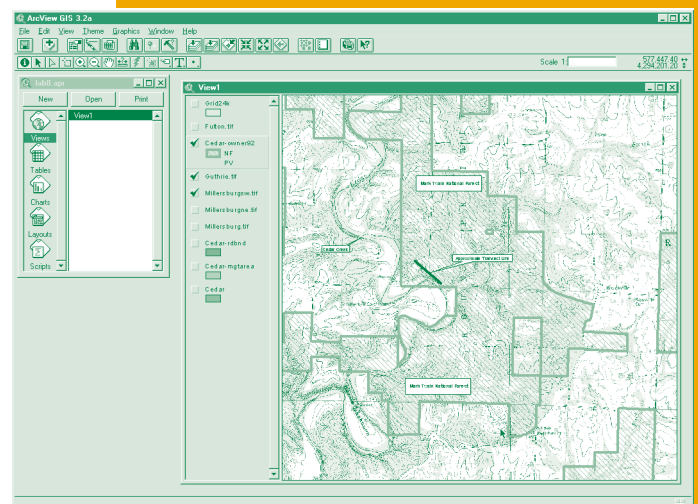
High school students can learn scientific inquiry and problem solving skills using GIS databases. Open-ended questions provoke opportunities to define problems, develop hypotheses, analyze information, draw conclusions and decide on action. GIS tools are especially helpful with questions regarding:

- Best location: Where is the best place for my store? Are there enough firehouse facilities for the community? Where should we build the next Conservation Center?
- Land use decisions: What should I grow on my land? How have we affected the landscape? Where are wet prairie restoration efforts most likely to be successful?
- Modeling landscapes: Where are vernal ponds likely to be found? Where else are the conditions for this endangered species likely to occur? What area can be seen from a fire tower?

Citizen monitoring programs provide real world opportunities to collect and share data. A local study site could be analyzed spatially in relation to elevation, population density and rainfall. The University of Wyoming offers GIS based lesson plans at <http://nasc.uwyo.edu/edparc/default.htm>, including instructions on how to download data from GLOBE and Journey North into GIS programs (see pages 2-3 for more information on GLOBE and Journey North).

GIS is playing an increasingly critical role in many fields. Introducing students to its applications will help them prepare for the future.

*by Ellen Ehrhardt, GIS Analyst
Missouri Department of Conservation*



GIS enables users to view the world as a series of stackable layers.

Mapping the Future

Getting Started With GIS

Starting a GIS is quite easy these days. You need a computer, GIS software and a little bit of time. Free GIS software packages are available. If your school does not already license GIS software, visit the Environmental Systems Research Institute's (ESRI) web site, <<http://www.esri.com>> for the free GIS program, ArcExplorer. Once you have installed ArcExplorer, you can begin to add GIS data that either you've collected on your own or downloaded (see list of websites below for sources of GIS data.)

ArcExplorer is easy to learn, however, you may need training to get started. Check ESRI's website for courses available free online or taught locally. A good place to begin learning about GIS is <<http://www.esri.com/library/index.html>> where you'll find a basic primer on GIS. The Missouri Department of Conservation is creating a GIS workshop for teachers; check future issues of *The Resource* for more information.

The GIS Program at the Missouri Department of Conservation can give you more information or help you incorporate GIS into your curriculum. Please contact Tony Spicci at <spicca@mail.conservations.state.mo.us> or 573.751.4115 x3259.

by Tony Spicci, GIS Coordinator
Missouri Department of Conservation

GIS on the Web!

Websites to help you become GIS savvy.

Sites For New Users

<<http://www.gis.com>> Internet guide to GIS
<<http://www.esri.com/news/arcuser/newtogs.html>> New Users Guide
<<http://www.3dillc.com/gisportal.html>> GIS Portal

Free GIS Software

<<http://www.esri.com/software/arcexplorer/index.html>> ESRI's ArcExplorer
<<http://www.esri.com/arcvoyager>> GIS application designed especially for schools

GIS Sites For Teachers

<<http://www.esri.com/industries/k-12/k-12.html>> ESRI's K-12 Program
<<http://www.elementkjournals.com/edu/0012/edu00c2.htm>> Educators guide to GIS in the classroom

Places to Download GIS Data

<<http://msdis.missouri.edu>> Missouri Spatial Data Information Service
<<http://nsdi.usgs.gov>> National Geospatial Data Clearinghouse
<<http://www.geographynetwork.com>> Geography Network

Important GIS Terms

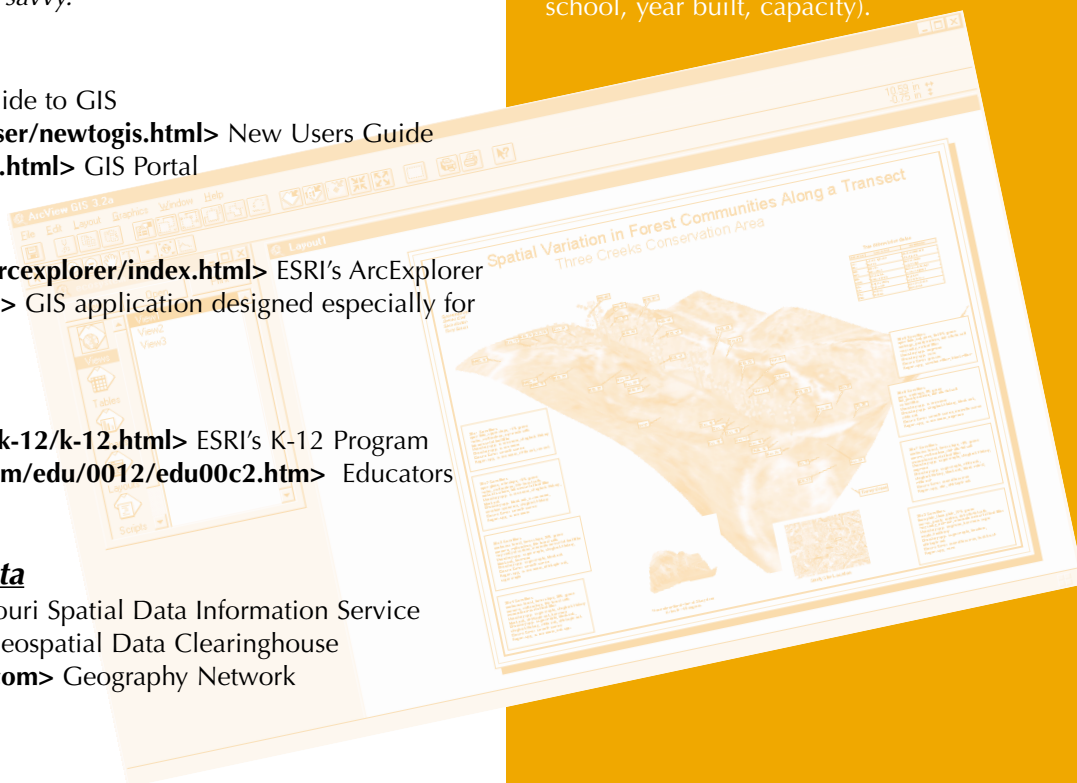
GIS - geographic information system - a computer based mapping system that allows people to look at different layers of spatial information in order to make informed decisions.

Layer - a grouping of similar features, such as ponds, roads, political jurisdictions or land cover types, stored as a single database.

Spatial Data - data that has an associated real-world location. This allows you to compare two different layers of information because they are both referenced to each other.

Feature - the individual elements that make up a layer (Layer = schools; features = Washington Middle School, Lincoln Elementary School).

Attribute - information about the features (e.g., name of school, type of school, year built, capacity).



WATER MONITORING



Global Rivers Environmental Education Network (GREEN) <<http://www.earthforce.org/green>>

Timeframe: Ongoing

Provides opportunities for young people to understand, improve and sustain local watersheds. GREEN teaches middle and high-school aged youth how to assess watershed health with the proper tools and then undertake projects to improve environmental quality based on their findings. Water monitoring equipment, resource guides and a network of support are provided.



Missouri Stream Teams

<<http://www.mostreamteam.org>>

Timeframe: Ongoing

A network of citizens concerned about Missouri streams. Stream Team membership is free to any interested citizen, family, school group or organization. Stream Teams often adopt a backyard stream, although doing so is not a requirement. Emphasizes education, stewardship and advocacy on behalf of Missouri streams. A Stream Team Curriculum guide is available by writing Mark Van Patton, <vanpam@mail.conservation.state.mo.us>.



Volunteer Water Quality Monitoring Program

<<http://www.mostreamteam.org/vm.html>>

Timeframe: Ongoing

Offers education, training and scientifically approved equipment. Volunteers are taught to monitor streams for their physical, chemical and biological aspects. The information gathered allows volunteers to see deterioration or improvements in water quality due to land use changes in the watershed. According to Priscilla Stotts, Missouri Department of Natural Resources Stream Team Coordinator, this program helps participants "gain first hand knowledge of how to run a streamside chemical test and how to interpret the information that is gathered."



Field Manual for Water Quality Monitoring*

Mitchell and Stapp. Provides instructions for anyone interested in understanding their local watershed. Details nine quality tests, as well as sections on heavy metals testing, land use practices and moving people to action. \$25.95.

Investigating Stream and Rivers*

Stapp, Cromwell, Schmidt and Alm. Promotes an interdisciplinary approach to understanding local watersheds. Focuses on student action taking and enhancing student involvement through computer conferences. Good supplement to the Field Manual for Water Quality Monitoring. \$14.95.

GREEN Low Cost Water Monitoring Kit*

A low-cost way to monitor local rivers and streams. Students analyze sample water for 8 test factors. Offers a safe and effective method to measure water quality in both the classroom and the field. \$27.95.

* Available from Earth Force/GREEN, 1908 Mount Vernon Avenue, 2nd Floor, Alexandria, VA 22301, 703.519.6877, <www.earthforce.org/green/catalog>.

Streamkeeper's Field Guide: Watershed Inventory and Stream Monitoring Methods

Murdoch, Cheo, O'Laughlin, Adopt-A-Stream Foundation. Sections on understanding watersheds, conducting field inventories, water quality monitoring programs, keys to plant and animal life, analyzing and presenting data and changing attitude and policy. Manual is adaptable for use by students, ages 12-adult. \$29.95. Acorn Naturalists, 17821 East 17th Street, Suite 103, Tustin, CA 92781-2423, 800.422.8886, <<http://acorn-group.com>>.

New Publication!

Environmental Education Materials: Guidelines for Excellence Workbook

The North American Association for Environmental Education (NAAEE) recently published a workbook to accompany *Environmental Education Materials: Guidelines*

for Excellence. The new publication consists of specific classroom activities and exercises that correspond to each section of the guidelines. Order forms are available online at <<http://www.naaee.org>>, or by contacting NAAEE's Publications Office, 706.764.2926.

Project Resource Guide: Citizen Monitoring



Project WILD



Project WILD: K-12 Activity Guide

Wildlife Is Everywhere! - Page 20 - Search your environment for evidence of wildlife.

Habittracks - Page 36 - Identify habitat components by using a map and exploring the schoolyard.

Tracks! - Page 52 - Identify common animal tracks.

Habitrekking - Page 56 - Conduct an outdoors investigation requiring observation, interpretation and data-gathering skills.

Learning to Look, Looking to See - Page 62 - Improve observational skills.

Environmental Barometer - Page 80 - Go outside to observe and count or estimate wildlife.

Urban Nature Search - Page 102 - Observe an area and use a questionnaire to gather data outside.

Wildlife Research - Page 198 - Evaluate types of research involving wildlife. Develop a research proposal and conduct research.

Bird Song Survey - Page 200 - Use bird-counting techniques.

Migration Barriers - Page 262 - Define migration and describe possible impacts on wildlife migration patterns as a result of human activities.

For more information on **Project WILD** and **PLT** workshops and materials, contact: Bruce Palmer, State Coordinator, Missouri Dept. of Conservation, PO Box 180, Jefferson City, MO 65102-0180, (573) 751-4115 extension 3113, <palmeb@mail.conservation.state.mo.us>.



Project WET



Project WET Curriculum and Activity Guide: K-12

Piece it Together - Page 174 - Analyze and plot global temperatures and precipitation distributions to determine climate patterns and how these influence human lifestyles.

Rainy Day Hike - Page 186 - Collect data about water flowing over the school ground and map the school's drainage area.

Stream Sense - Page 191 - Use your senses to observe a stream.

A-maze-ing Water - Page 219 - Guide a drop of water through a maize of "drainage pipes" to learn how actions in the home and yard affect water quality.

Where Are the Frogs? - Page 279 - Learn how acidic water has endangered the quality of aquatic life in some parts of the country.

Macroinvertebrate Mayhem - Page 322 - Play a game of tag to simulate the effects of environmental stressors on macroinvertebrate populations.

The Pucker Effect - Page 338 - Observe how ground water transports pollutants and simulate ground water testing to discover the source of contamination.

Reaching Your Limits - Page 344 - Experience the effort involved in meeting drinking-water quality standards.

For more information on **Project WET** workshops and materials, contact Joe Pitts, State Coordinator, Missouri Dept. of Natural Resources, Technical Assistance Program, PO Box 176, Jefferson City, MO 65102, (800) 361-4827.

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Project Learning Tree



Project Learning Tree Environmental Education Activity Guide: PreK-8

Adopt A Tree - Activity 21 - Monitor a tree throughout the year for signs of animal or human activity, leaf fall and tree bloom.

Are Vacant Lots Vacant? - Activity 47 - An overgrown strip of land provides a rich laboratory for students to examine elements of an ecosystem.

Field, Forest and Stream - Activity 48 - Explore three different environments for sunlight, soil moisture, temperature, wind, plants and animals.

Bursting Buds - Activity 65 - Observe treebuds throughout the year to learn more about the formation of leaves.

How Big is Your Tree? - Activity 67 - Measure trees and become familiar with their structure.

Soil Stories - Activity 70 - Explore differences in soil types.

Trees in Trouble - Activity 77 - Examine trees for damage or poor health.



Leopold Education Project



Leopold Education Project: Striving for a Land Ethic

January Thaw - Page 1 - Identify and interpret animal signs in winter.

The Geese Return - Page 12 - Identify two types of waterfowl through direct observation and by using a field guide.

Back from the Argentine - Page 24 - Identify migratory birds and their summer, winter and permanent residences on a map.

The Alder Fork - A Fishing Idyl - Page 28 - Identify fish and record temperature and depth of an aquatic area.

A Prairie Birthday - Page 36 - Record the number of plant species in bloom in two different locations and compare findings.

The Choral Copse - Page 43 - Recognize changes in animal behavior and plant life due to seasonal changes.

Axe-in-Hand - Page 60 - Measure the growth of a tree's stem and then make assumptions about the environmental growing conditions.

65290 - Page 74 - Explain the process and purpose of banding birds and study bird adaptations for survival.

For more information on **LEP** workshops and materials, contact Janice Greene, State Coordinator, Biology Dept., Southwest Missouri State University, 901 S. National Ave., Springfield, MO 65804, (417) 836-5306 or at <JaniceGreene@mail.smsu.edu>

Snapshots from the Field

Teachers and students throughout Missouri are involved in a variety of environmental monitoring projects. Here are just a few examples. See "The Library" section (pages 2-3) for profiles of the projects in which these schools are involved.



Missouri School for the Deaf

Michael Stultz (high school biology, environmental science, and chemistry), 505 East Fifth Street, Fulton, MO 65251, Callaway County, 573/592-2515, <mstultz@msd.k12.mo.us>

Three environmental monitoring projects are located at the school's outdoor classroom. Missouri Stream Team #809, the Outdoor Club and the environmental science class organize litter pick-ups and conduct bio-monitoring and chemical water quality tests in the fall and spring on the Smith Branch stream. Each fall, the environmental science and environmental technology classes report to the Missouri Forestkeepers Network on the health of trees in a designated plot. These classes also participate in Global Learning and Observation to Benefit the Environment (GLOBE) and are responsible for collecting and reporting data on: cloud cover and cloud type; rain and snow measurement; maximum, minimum and current air temperature. Says Stultz "I find that the students retain more information through this type of hands-on learning."



Summersville R-II Schools

W. I. (Bill) Wells (Gifted Facilitator 7-12 & Special Education Coordinator), 400 Rogers St, PO Box 198, Summersville, MO 65571, Texas and Shannon Counties, 417-932-4929, <wellsb@hs.summersville.k12.mo.us>

Wells discovered Monarch Watch when looking for a hands-on project centered on "real world" issues. Approximately twelve students in grades 7-10 in Wells' gifted program participate in the project each year. During the 1998-99 school year, Wells' students studied the life cycle of monarchs, built a flight cage to hold and breed monarchs, dug milkweed plots, and constructed a wall-size US map to track the return migration north in the spring. They tagged about 100 monarchs during the 1999 fall migration and 69 adults in the 2000 fall migration. One of their tagged butterflies was recovered in Cerro Pelon, Mexico, 118 days after its release, having traveled 1,331 miles! In addition to tagging, the students grow plants in a greenhouse, including milkweed for larvae forage and nectar plants for adult monarchs, and transplant them to butterfly plots on the school grounds. Says Wells, "Several of my students are now making efforts at home to provide "butterfly-friendly" environments. I suspect that, in the long term, the specific information learned about monarchs will be less important to them than the increased awareness of the diversity and value of life in our natural world."

Ferguson Middle School

Barbara Rain (8th grade science), 701 January Ave. Ferguson, MO 63135, St. Louis County, 314-506-9634, <bmrain@postnet.com>

Rain's 8th grade science classes pay weekly visits, starting in February, to Journey North's website following the monarch butterfly migration from Mexico. Students make daily observations using forms provided by Journey North that document when the migration begins, peaks and ends in their area. Using Journey North's teacher manual, Rain helps her students learn about adaptations, habitats, populations, and ecosystems; write a scientific paper; and create a hallway display that includes a weekly list of monarch sightings. Says Rain, "it is real science, with all the complications and interrelationships that are a part of real life. There is no way to get this kind of complexity in a laboratory set up . . . where the teacher knows the outcome . . . I didn't know what was going to happen either." In addition to tracking the monarch butterfly migration, Journey North follows migrations of Ruby-throated hummingbirds, Humpback whales and many other species.

Nipher Middle School

Janelle Jones (6th grade general science), 700 S. Kirkwood Road, Kirkwood, MO 63122, St. Louis County, 314/213-6100, ext. 8202, <jonesja@gw.kirkwood.k12.mo.us>

Sixth grade Team Six West begins each year with a unit on water. As a Stream Team, the students monitor and submit data throughout the year on Sugar Creek, conducting monthly tests on dissolved oxygen, nitrates, temperature of air and water, turbidity, pH and conductivity, as well as a biannual macroinvertebrate count. Students have found that nitrate levels go up in the fall and spring around the time when many people fertilize lawns and that dissolved oxygen levels drop for a few weeks in the fall as leaves decay. Students have presented findings at Kirkwood School Board and Kiwanis Club meetings. Says Jones, "It is a chance to do real science in the field. For most students it is a great motivator. For me, it is the chance to give students an opportunity to see that they can make a difference." Jones' students have also been able to use GIS maps (see pages 4-5) of their watershed to interpret their results and consider how local features may have an impact on their water quality test results. For a more detailed account of how GIS was used, visit <<http://www.spatialnews.com/newsletter/2000/20/mbot.html>>.

Gallatin R-V

Dennis Steigerwalt (high school biology/science), 602 S. Olive Gallatin, MO 64640, Daviess County, 660/663-2171, <steig@ponyexpress.net>, <txu004@mail.connect.more.net>

Students in Steigerwalt's environmental mapping course collect atmospheric and hydrologic data on the school's pond for Global Learning and Observation to Benefit the Environment (GLOBE). Steigerwalt plans also to start teaching about soil and land cover biology and hopes to combine GLOBE and Stream Team in a summer course. The Stream Team, which is part of Steigerwalt's advanced biology class for seniors, currently monitors a section of the Grand River from Jameson to Gallatin. The students noticed a rise in pollutants when waters were low last summer. They also found that the oxygen content dropped in the fall when plant matter around the edges started to die and surface algae was high. Says Steigerwalt, "My main purpose is to expose students to measuring environmental factors in hopes that they will develop a concern and care for our environment, especially locally in Missouri."



St. Francis Xavier School

Sandy Callahan (Kindergarten), 7307 Rt. M, Jefferson City, MO 65101, Cole County, 573/395-4612, <angel893@aol.com>

Callahan's Kindergarten class participates in Project Groundhog, a 6-week weather monitoring Internet project that takes place January through March. Students make predictions, collect and submit weather related data and communicate via e-mail with their "keypals," Kindergarteners

in Pennsylvania who live near Puxatany Phil. Students can access the website at <<http://www.stemnet.nf.ca/Groundhog>> to view other schools' activities and weather data.

The College School of Webster Groves

Gerald Axelbaum and Mary McGeathy (fifth grade), 1 Newport Place, St Louis, MO 63119, St. Louis, 314-962-9355, <geraldaxe@aol.com>

Fifth graders at the school have, since 1994, been tagging monarch butterflies to help Monarch Watch, a University of Kansas research program, track the pathway monarchs follow to their winter nesting grounds in Mexico.

Each fall, the students make three trips to the Missouri Botanical Gardens' Shaw Arboretum to catch, tag and release monarch butterflies. A 1 cm diameter self-adhesive tag, which is non-toxic and does not affect flight, is applied to each captured monarch's hind wing. Each tag has a 5-digit number and the address of Monarch Watch. The students also identify the monarch's sex and evaluate and record the wing

condition before releasing it and recording its "vanishing bearing." In May 2000, a male monarch that the students tagged in September 1999 was recovered in El Rosario, Mexico after having flown at least 1,419 miles. A key benefit says Axelbaum, is that "students see how to collect and analyze data . . . Their observation skills improve and they form a stronger connection to the natural world."

photos by: Cliff White

Environmental Monitoring

Taking Field Experiences to the Next Level

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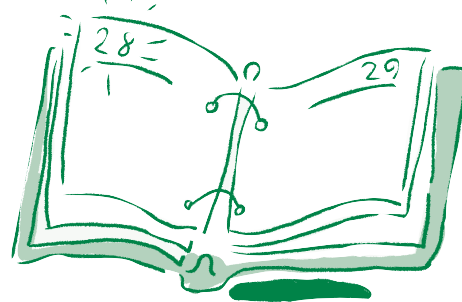
scout groups tag monarch butterflies that are migrating south to Mexico. These children and adults along with thousands of others are contributing to Monarch Watch's database of tagging and recovery information, which in turn is used by scientists to document the 2500-mile flight paths and migratory habits of the monarch. Beyond the powerful impact that holding a monarch in your hand has on a person, the annual tagging effort contributes important scientific data used in formal research. Browsing the Monarch Watch website (see page 3) allows you to see the ways in which "amateur" data is used to support formal scientific research.

Similarly, participants from across North America involved in the Cornell Lab of Ornithology's FeederWatch and similar citizen-science programs document the birds that visit their feeders over the course of the winter and spring, leading to many fascinating questions of habitat and seasonal change. In my previous life as a classroom teacher, my 3rd and

4th grade students documented which birds came to the school feeder, and through bi-weekly field trips to the nearby Litzinger Road Ecology Center, which species visited the more natural setting found at the Center. Not surprisingly, a much greater diversity of species was found at the Center, providing a powerful lesson for the students about the importance of habitat preservation in promoting biodiversity. All of the FeederWatch data was reported to the Cornell Lab of Ornithology, which uses the data in their ongoing research of bird populations. With more than a century of data from volunteer monitors available online, changes in populations can be documented readily.

The programs, organizations, curricula and local examples featured in this issue of *The Resource* all use the fascination that environmental monitoring engenders in naturalists of all ages to stimulate learning. Choose one and begin your own investigations—you'll be amazed at the windows on the world that are opened!

EECalendar



April 7-8

Household Hazardous Waste

Jefferson City
Learn about HHW through sample activities and a visit to the HHW collection facility in Columbia. One hour grad credit, Lincoln University (\$60). \$30 registration fee. Contact Joe Pitts or Jim Lubbers, Missouri Department of Natural Resources, 573.526.6627 or 800.361.4827.

April 10

Project Learning Tree

Litzsinger Road Ecology Center, Ladue
9 am - 4 pm. Teachers grades K-8.
Learn to use the PLT curriculum guide containing nearly 100 activities correlated to the MO Show-Me Standards. \$20. Contact Celeste Prussia, 314.577.5117.

April 16-28

National Wildlife Week 2001: Nature in your Neighborhood

Each day of NWW will highlight a particular geographical region's conservation education efforts. The Midwest region (including Missouri) will be celebrated on Thursday, April 19. Visit www.nwf.org/wildlifeweek/index.html for online updates, interactive games, activity sheets, TV program guide and more!

April 21

Earthfest 2001

Discovery Center, Springfield
10 am - 5 pm. Includes Steve Trash (environmental magician), animal shows, exhibitors and volunteer recruitment. Free admission. The Discovery Center is also scheduled to open a permanent exhibit entitled Our Watershed, featuring Ozarks karst environment. Contact Ann Carter, 417.862.9910, Ext. 701.

April 21-22

Sedimentary Geology

Dr. Edmund A. Babler Memorial State Park, Chesterfield
Focuses on the geology of sedimentary deposition in Missouri. Participants will collect rock specimens. Topics include principles of deposition, compaction and cementation of sediments into sedimentary rock, sedimentary structures, land formations and rock identification. One hour grad credit, Lincoln University (\$60). \$30 registration fee. Contact Joe Pitts or Jim Lubbers, Missouri Department of Natural Resources, 573.526.6627 or 800.361.4827.

April 22, 27

Earth Day Graduate Credit Teacher's Course

St. Louis
Visit the "Teacher's Tent" at the Earth Day Festival on Sunday, April 22 at the World's Fair Pavilion in Forest Park. Experience hands-on activities from the teacher's guide that you can use with your students. In addition, attend the symposium, "Our Water, Our Rivers: St. Louis as a 21st Century River City" to be held at the Missouri Botanical Garden on April 27. For information about grad credit, contact the St. Louis Children's Aquarium, 314.647.6011. For information on St. Louis Earth Day activities and teacher resources, contact 314.962.5838 or visit www.stlouisearthday.org.

April 27-29

HOOT (Hands-On Outdoor Training)

YMCA of the Ozarks, Potosi
An opportunity for the whole family to enjoy a weekend outdoors. Courses include canoeing, fishing, horsemanship, rifle and shotgun, outdoor cooking and climbing. Minimum age to attend is 4. Fee

Check It Out

www.conservation.state.mo.us/teacher/workshops
has up-to-date information on the Department of Conservation's teacher workshops. There's something for everyone!

ranges from \$50-150 per person depending on your choice of lodging. Fees include meals. Contact Stephanie Upton, Missouri Department of Conservation, 573.751.4115, hughem@mail.conservaation.state.mo.us.

April 28

Leopold Education Project

Shaw Nature Reserve, Gray Summit
9 am - 4 pm. Teachers, grades 6-12.
Learn how to follow in the footsteps of Aldo Leopold and "teach the student to see the land, to understand what he sees, and to enjoy what he understands." \$30 (includes teacher's guide). Contact Celeste Prussia, 314.577.5117.

June 1-5

Investigating and Evaluating Environmental Issues and Actions

Presley Conservation Education Center, Salem
IEEIA focuses on investigating and evaluating environmental issues and actions using higher order thinking skills. Sessions will prepare educators (grade four through adult) on instructional methods of issue investigation. Two hour grad credit, Lincoln University (\$120). \$30 registration fee (includes lodging and meals). Contact Joe Pitts or Jim Lubbers, Missouri Department of Natural Resources, 573.526.6627 or 800.361.4827.

June 13-14

Animal Artistry

Saint Louis Zoo

8:30 am - 4:30 pm. Teachers, grades 4-8. Connect science and art in your curriculum by examining colors, textures and patterns in nature and doing related art projects. All materials provided. \$35 Lab Fee, one hour grad credit through Lindenwood University optional (\$60 tuition). Contact St. Louis Zoo, 314.768.5466.

June 17-20

Forestry Institute for Teachers

Presley Conservation Education Center, Salem

Learn the knowledge, skills and tools to teach students about forest ecology and forest management. Through field studies, hands-on activities and group projects, you will gain a better understanding of the interrelationships of forest ecosystems and how their management impact the needs of Missouri citizens. 2 hours undergrad/grad credit. \$212 for credit; \$84 to audit. Contact Bruce Palmer, 573.751.4115 x 3113, <palmeb@mail.conservation.state.mo.us>.

June 25-27

Stream Environments

Presley Conservation Education Center, Salem

Examine the ecology of Missouri streams. Topics include geology, hydrology, natural history, aquatic biology, topography and Ozark culture. Includes a one-day float on the Current River. One hour grad credit, SMSU (\$106). \$30 registration fee (includes lodging, meals and canoe rental). Contact Joe Pitts or Jim Lubbers, Missouri Department of Natural Resources, 573.526.6627 or 800.361.4827.

July 9-10

Use Less Stuff – Waste Less Stuff

Columbia

Meets concurrently with the annual Missouri Waste Control Coalition conference. Attend plenary sessions, most meals, review exhibits and meet as a separate group for field trips, discussions and classroom applications of best management practices for waste reduction and sustainable resource use. One hour grad credit, Lincoln University (\$60). \$30 registration fee. Contact Joe Pitts or Jim Lubbers, Missouri Department of Natural Resources, 573.526.6627 or 800.361.4827.

July 10-12

Animal Adaptations and Behavior

Saint Louis Zoo

Teachers, grades K-8. An introduction to the ways animals survive and thrive. \$25 Lab Fee, one hour grad credit through Lindenwood University optional (\$60 tuition). Contact St. Louis Zoo, 314.768.5466.

introduced to curricula like Monarch Watch and outdoor classroom activities. \$40 Lab Fee, one hour grad credit through Lindenwood University optional (\$60 tuition). Contact St. Louis Zoo, 314.768.5466.

August 11 & 18

Wild Wonders for Wee Ones

Saint Louis Zoo

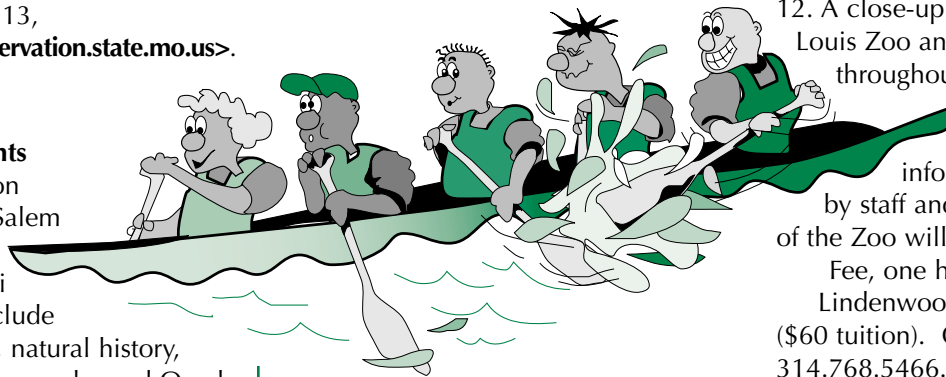
8:30 am - 4:30 pm. Educators of early childhood preschools and centers. Bring the Zoo to life in your classroom and bring the life of the Zoo to your young learners. This workshop is designed to assist you when you come to the Zoo on field trips as well as provide your students with active, hands-on, animal-related activities. \$35 Lab Fee, one hour grad credit through Lindenwood University optional (\$60 tuition). Contact St. Louis Zoo, 314.768.5466.

August 18-19

Endangered Species and Zoo Conservation

Saint Louis Zoo

8:30 am - 4:30 pm. Teachers, grades 6-12. A close-up look at how the Saint Louis Zoo and modern zoos throughout the world work to conserve species. Activities, background information, a presentation by staff and tours of selected areas of the Zoo will be featured. \$35 Lab Fee, one hour grad credit through Lindenwood University optional (\$60 tuition). Contact St. Louis Zoo, 314.768.5466.



July 25-26

Spineless Wonders: Monarchs, Mantids & More

Saint Louis Zoo

8:30 am - 4:30 pm. Teachers, grades 4-8. Learn about the invertebrate world on Thursday and focus in on butterflies Friday. Topics covered include: life cycles and other life processes of invertebrates, adaptations, behaviors, biodiversity and conservation. You will be

Paper Facts

Environment Recycled Paper is made from Over 75% recycled paper including 25% post consumer fibre.





Conservation Curriculum

Monitor Your World!

Here's a chance to use and improve your monitoring skills. The preK-4 activity, "Monarchs and Viceroy's," (pages C2-C3) acts as a supplement to programs like Project Monarch Watch and Journey North. Students learn to identify monarch and viceroy butterflies and explain why these butterflies look so much alike.

"Birding 101" (pages C4-C5) is geared towards skill enhancement – in this case birdwatching. Use these tips to help you get started in programs like Classroom FeederWatch and the Great Backyard Bird Count. As a supplement, we have provided a pull-out poster displaying basic bird identification tips.

"Mapping Missouri Fish" (pages C6-C7) allows students to conduct research on the internet and create maps for the distribution of a group of fish. This activity could be easily incorporated into a project or explanation of GIS (see pages 4-5). The previous two activities are adaptable for any age level and do not indicate grade level.

Let us know what you think about the "Birding 101" format and poster! Would you like to see more skills enhancement information, or would you rather have activity plans? Send your comments to: <grayg@mail.conserva-tion.state.mo.us>.

Missouri Department of Conservation's Education Website

<www.conserva-tion.state.mo.us/teacher>

Check out the Missouri Department of Conservation's education website. Much of the MDC education curriculum is now online and available for all grade levels. Materials cover various levels and topics and are interdisciplinary to help instructors reach program goals. *The Resource* is downloadable from this site. A special feature allows you to search for information on various topics including reptiles, prairies, birds and more. This site also displays the most current information on all teacher workshops given by Conservation Education Consultants.

The Conservation Department's Kid's Page (<<http://www.conserva-tion.state.mo.us/kids>>) is also expanding. Have students play our online, multimedia game, "Leaf Invaders." They'll have a great time and learn how to identify common Missouri leaves!

Outdoor Classroom GRANTS



Outdoor Classroom grants will be available for the 2001-2002 school year. Revenue for the grants was generated from sales of conservation license plates, by the Missouri Conservation Heritage Foundation, and matching funds from the Missouri Department of Conservation. All schools registered with the Department of Elementary and Secondary Education are eligible to apply for these grants. Grants are available for a wide array of outdoor classroom projects and requests may be up to \$2,500.

Your grant application will require that you contact your local Conservation Education Consultant (CEC) and arrange for a site visit prior to grant evaluation. You need to contact your local CEC as soon as possible, as their schedules fill quickly. If you do not know your local CEC, you may e-mail <oece@mail.conserva-tion.state.mo.us>.

To obtain a grant application either send us an e-mail or write to:

Outdoor Classroom Grants
Missouri Department of Conservation
PO Box 180
Jefferson City, MO 65102-0180

**Application
deadline
May 4, 2001!**



Monarchs and Viceroy



PreK-4

Objectives:

After completing this activity, students will be able to:

1. Identify differences between viceroy and monarch butterflies [1.6]
2. Explain why viceroys and monarchs have similar wing patterns [SC3]

Materials:

copy page (copy on white), crayons, popsicle sticks (optional), masking tape (optional)

Procedure:

1. Introduce students to monarch and viceroy butterflies.
2. Provide each student with a copy page. Have students color the butterflies.
3. Have students list or tell similarities and differences about the two pictures. Discuss these observations as a class.
4. Explain why it is advantageous for the viceroy to mimic the monarch.

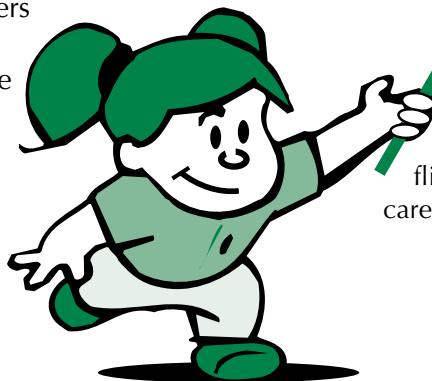
Extension:

Have students cut out monarch butterflies from the copy page and tape onto popsicle sticks. Reenact the monarch's migration in your classroom or outside, using the background information as a guide.

Monarch Butterfly

The monarch is the best-known butterfly in North America. An adult monarch has wings of a striking reddish-brown, with black veins, black borders and two rows of white dots. Its wingspread can reach up to 4 inches.

Although many insects migrate, the monarch is the long distance butterfly champion! Each autumn, Missouri monarchs join others that have come from as far away as Canada and migrate south to a small alpine fir forest in Mexico. Each monarch (weighing only about half a gram) can migrate over 2,000 miles. The trees in the fir forests may be completely covered with monarchs!



Monarchs leave their wintering grounds in March. On the northward journey, females stop to lay eggs on the underside of milkweed plants and die shortly thereafter. The offspring continue to migrate, returning to the same North American regions where their parents lived.

When monarch larvae feed on milkweed plants, they accumulate a poisonous substance in their bodies that makes them distasteful to birds and other predators. Birds learn to recognize the butterflies' bright pattern and avoid eating them.

Viceroy Butterfly

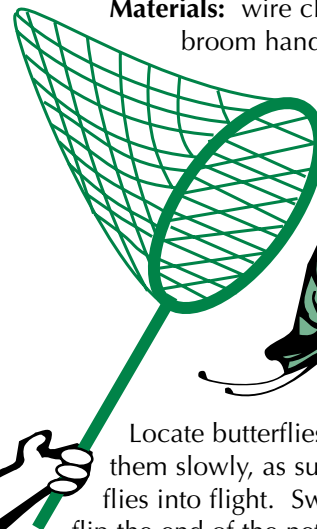
The viceroy butterfly is a black-and-orange non-poisonous butterfly that is very similar to the monarch. It can be distinguished from the monarch by the black line that crosses its wings. The viceroy is an edible species, but because it looks like the distasteful monarch, it is seldom bothered by predators.

Viceroys do not migrate. The eggs of the viceroy are laid at the tips of oak, willow, birch or linden leaves. The viceroy caterpillar feeds on the leaf tip on which it was hatched and then undergoes metamorphosis into an adult the following spring.

How to Make a Butterfly Net:

Materials: wire clothes hanger, 5-gallon paint strainer, broom handle or wooden dowel, duct tape

- Bend the hanger into a square
- Sew the 5-gallon nylon paint strainer onto the hanger as a net.
(Paint strainers are available at most paint stores for about \$1.25 each).
- Connect the wire hanger to a broom handle or wooden dowel with duct tape.



Locate butterflies feeding on flowers. Approach them slowly, as sudden movements will startle butterflies into flight. Sweep the net forward quickly and flip the end of the net bag over the net handle. Observe carefully and release.

Monarchs and Viceroy

Name: _____

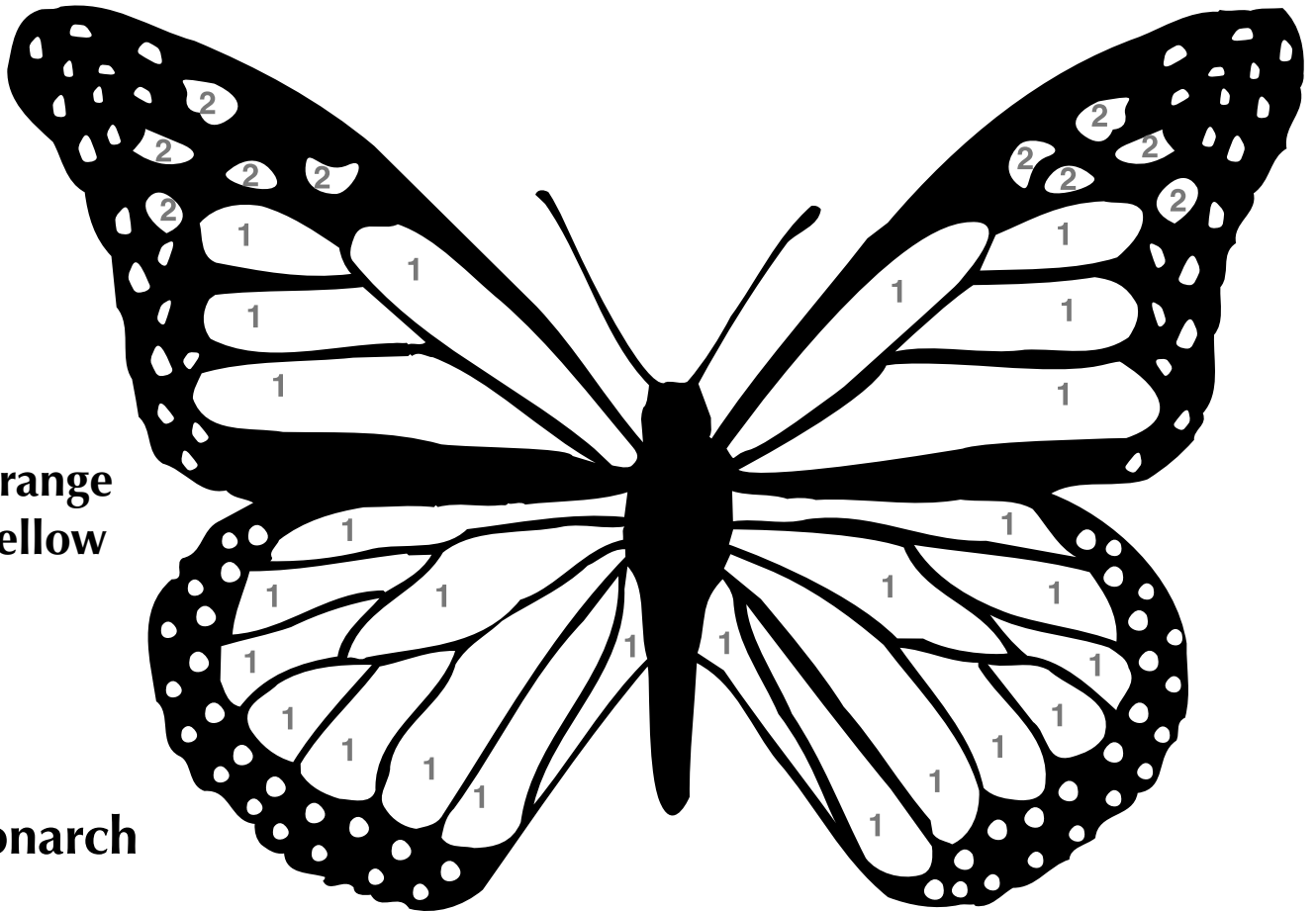
Directions: Color the wings of both butterflies by following the key. How are these two butterflies alike? How are they different?

Key

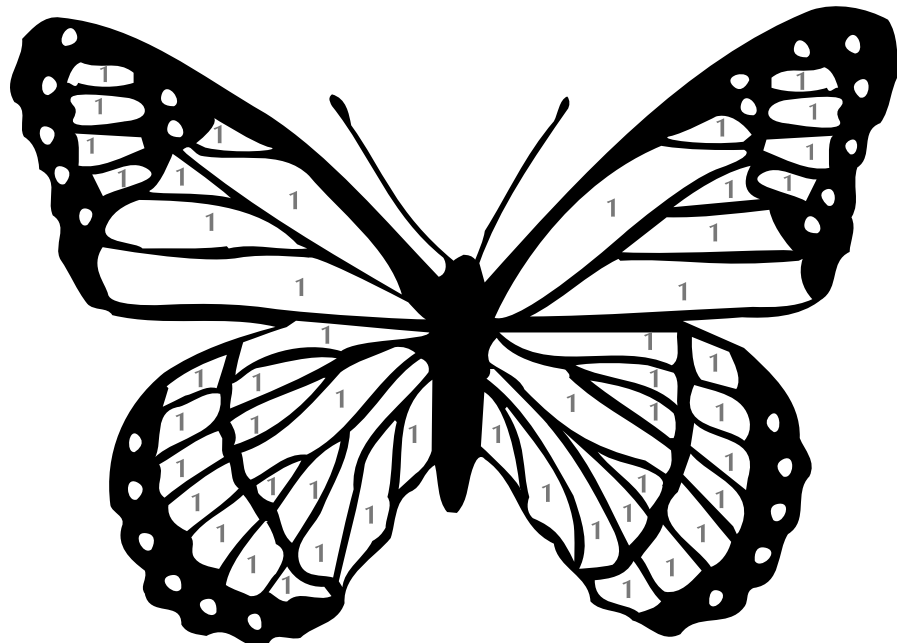
1 = orange

2 = yellow

Monarch



Viceroy



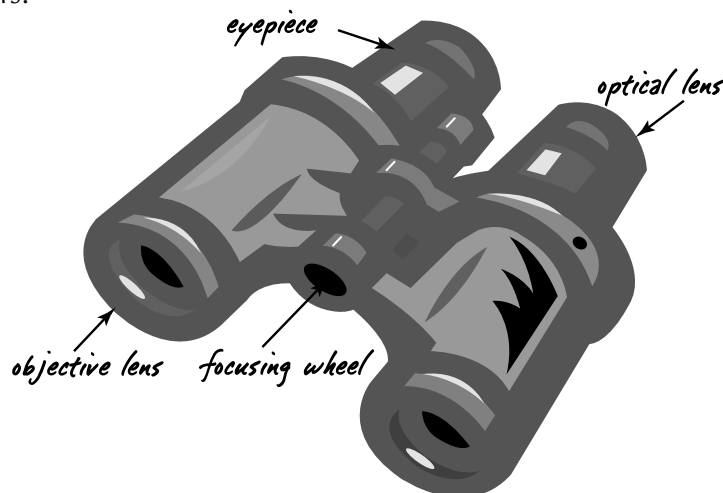
Birding 101

Bird watching is one of the nation's favorite pastimes! It's easy to get started – all you need is a good field guide and binoculars.

Binocular Basics:

Binoculars are very important, if not essential, to bird watching. Here are a few tips to help you make the most of your viewing time.

1. **What do the numbers mean?** Most binoculars have two numbers printed on the body that are separated by an "x" (example: 7x35 or 8x40). The first number shows magnification power and the second indicates diameter of the objective lens in millimeters. The larger the diameter, the brighter the image. Most popular among experienced birders are the binoculars designated as either 7x35 or 8x40. Those larger than 10x50 tend to be overly bulky and difficult to hold steadily.
2. **A two for one view!** Most binoculars have a hinge holding both sides together. This allows users to adjust for the distance between their eyes. If you don't adjust the hinges properly, you may see black spots or two separate images of the same bird. Push or pull the sides apart until you see one circular image.
3. **Eyeglasses remedies.** With some binoculars, a person wearing glasses can see only 60 percent of the field of view. Adjustable eye cups that screw or fold down can partially increase the field of view.
4. **Don't forget to adjust the eyepiece!** Focusing binoculars is a two-step process. The main focusing wheel will bring an item into focus, but you may also need to adjust for differences in the strength of each eye. To correct for your eyes, focus on an object at a middle distance. With your right eye closed, turn the main focusing wheel until the image looks clear to your left eye. Then, with your left eye closed, slowly turn the eyepiece until the image is crisp for your right eye. When you're finished, look at the eyepiece scale, and use that setting whenever you use these binoculars.
5. **Voila!** Now for the tricky part – getting the binoculars to your eyes without losing sight of the bird. Practice keeping your eyes on the bird, and bring the binoculars to your eyes. For optimal comfort, binoculars should hang about six inches below your chin.



Bird Identification Field Guides:

The three recommended are each illustrated in color, show range maps for all species and contain a birder's checklist. They are standards in the field and are available at most bookstores.

1. **A Field Guide to the Birds**, written and illustrated by Roger Tory Peterson. Published by Houghton Mifflin Co., Boston. The eastern edition covers all birds east of the Rocky Mountains and north of Mexico. Great for beginners. Features arrows that point out distinguishing field marks from similar looking birds.
2. **Birds of North America**, by Robbins, Bruun and Zim. Illustrations by Arthur Singer. Published by Golden Press, New York. Covers all birds native to North America north of Mexico.
3. **Birds of North America**, by the National Geographic Society. Covers all birds of North America north of Mexico.



Birding 101

Keep a Birders Journal!

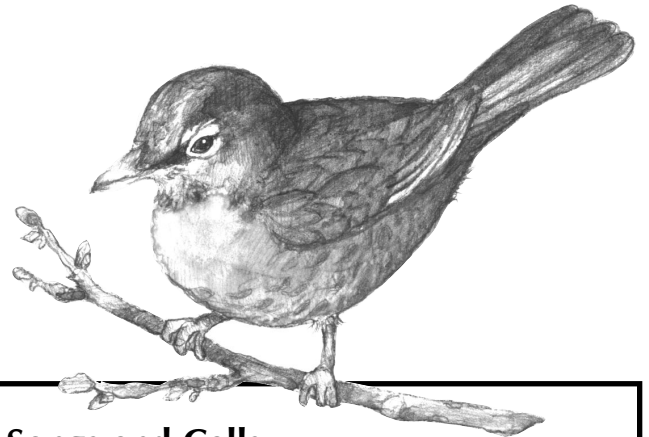
Start with a pocket-sized notebook. When recording your observations, include the following essential information – the date (day, month, year), time of day, location (as specific as possible; include the city, county and state. Write the location so that anyone could find the site 50 years from now), weather conditions, your name and the people with you. Then, write down details of what you see - bird species, numbers, ages, sexes, plumage, field marks and other identifying characteristics. Make sketches from your observations.

Start Your Life List Today

Many bird watchers set a goal of spotting as many bird species as possible. To keep track, they keep a life list – a list of every type of bird that they have ever identified. An average list for a bird watcher in North America might include 300 to 500 birds. Bird watchers who travel the world often have more than 6,000 birds on their list. Make a spot in your notebook to list every species that you encounter.

Identification Tips:

1. Talk softly to yourself when watching a new bird. Describe it to yourself: e.g., "It has an eye ring, two wing bars and is streaked underneath." This will help you remember the traits when looking in a field guide.
2. Go birding with avid birders! Local organizations such as the National Audubon Society are always willing to assist budding birders! New birders are welcome to join bird walks with the different Audubon Chapters around the state, and you don't have to be a member to tag along. Experienced birders will be able to show you behavioral traits to watch for and may help you realize the importance of listening. To find the nearest Audubon chapter to you, visit www.audubon.org/chapter/mo/mo.



Bird Songs and Calls:

Many birds have voices that may be described with words or syllabifications for easy identification. Missouri Bird Calls, a 45-minute audio tape, may be ordered by writing to Nature Shop, Missouri Department of Conservation, P.O. Box 180, Jefferson City, MO 65102. Please call 877-521-8632 (toll free) for pricing information.

Killdeer

"killdeer, killdeer, killdeer..." loud and repetitious

Northern Flicker

"flicka, flicka, vlicka, vlicka, vlicka" loud and sharp also a loud piercing call like a slice in the air "teeuw"

Chickadee

"chick-a-dee-dee-dee" busy call notes, 1st note highest song is a whistled "spring-soon" the second note a full tone lower than the first

American Robin

"cheer-up, cherrily, cherrily, cheer-up" whistled and caroling with breaks between phrases

White-breasted Nuthatch

"what, what, what, what" or "yank, yank" very nasal

Mapping Missouri Fish!



Objectives: After completing this activity, students will be able to:

Performance Skills

1. Use technological tools to locate, select and organize information. (1.4)
2. Discover and evaluate patterns and relationships in information. (1.6)
3. Organize information into useful forms for analysis and presentation. (1.7)

Content Knowledge

1. Construct maps with proper titles, legends and orientation; use those maps to process and report information; and develop and answer questions. (SS7; Grade 8 benchmark)
2. Organize information and demonstrate the appearance and diversification of *Notropis* distribution in Missouri. (SC3; VII.E)

Materials: Internet access (or copies of *Notropis* distribution by county), copy page (at least 4 per student), Colored pencils (optional) or computer graphics program (optional)

Background:

Minnows in the genus *Notropis* are most commonly known as shiners. Minnows are found in nearly all natural waters of the state. Each species has its own particular habitat requirements, and few are distributed statewide. Those with similar requirements tend to have similar distributions, with each section of the state and each habitat having its own characteristic minnows.

Procedure:

1. Have students read, "Who's Watching Fish" and "How Fish Swim" in the May issue of *Outside In*.
2. Discuss fish characteristics and habitat. Have students access the Missouri Fish and Wildlife Information System (MOFWIS) on the Internet, www.conservation.state.mo.us/nathiso/mofwis.

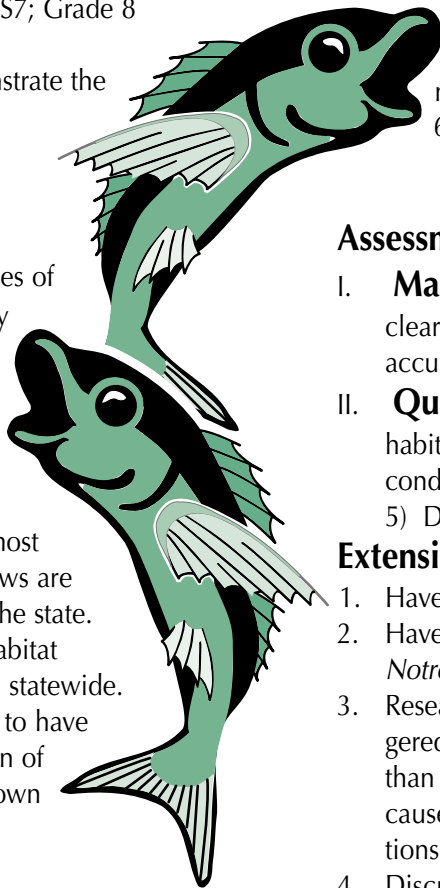
3. Students can then search the database by selecting "Fish" and entering "*Notropis*" as the scientific name. Select an entry, then select "Detailed Report" to find the county occurrences for each species.
4. Break the class into groups of 4-6 students. Provide each group with 24 copies of the county map of Missouri. Have groups select a method for creating legends and titles that would provide some consistency for comparison of individual maps.
5. Each group will do distribution maps of the 24 species of *Notropis* in Missouri. They should divide the work evenly between them (each member will do 4-6 maps). Have each individual create distribution maps using the group's criteria for titles and legends.
6. After they create the maps, have groups compare their maps. Do patterns exist? Have students develop a list of questions based on their observations?

Assessment:

- I. **Maps:** 1) Are they properly titled? 2) Is the legend clear? 3) Did they include orientation? 4) Is the coloring accurate for the distribution?
- II. **Questions:** 1) Concise vs. Vague. 2) Do they question habitat requirements? 3) Do they question environmental conditions? 4) Do they question species characteristics? 5) Do questions require thought and research?

Extensions:

1. Have students research one of their questions.
2. Have students prepare presentations on one species of *Notropis*.
3. Research the Topeka Shiner (*N. topeka*), a Missouri endangered species. What makes this species more vulnerable than others in the genus *Notropis*? What do you think caused the patchiness of remaining Topeka Shiner populations?
4. Discuss how data on the MOFWIS system might have been collected. What is the importance of continual monitoring of sites for biological diversity?
5. GIS Extension! Use ArcVoyager (a free GIS program for classroom use available at <http://www.esri.com/arcvoyager>) to map distributions on county maps. See pages 4-5 for more information on GIS.



Mapping Missouri Fish!






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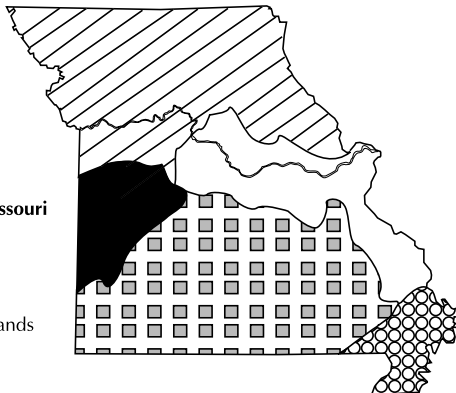
C-7

Title: _____



Natural Divisions of Missouri

-  Glaciated Plains
-  Ozark Border
-  Osage Plains
-  Ozark
-  Mississippi Lowlands



LEGEND:

TEACHER resources

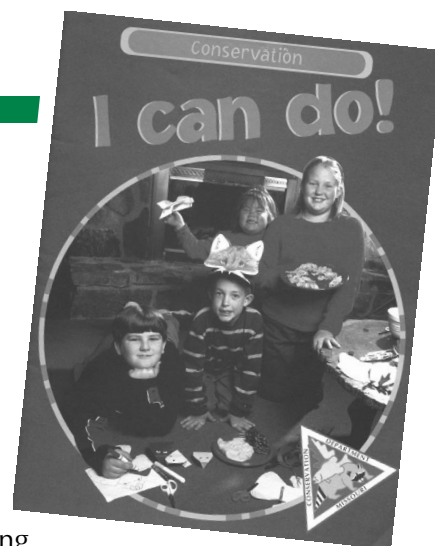
Missouri Songbirds Poster

Take a look at the revised Missouri Songbirds Poster! This spectacular, full color poster displays 20 of Missouri's most prominent songbirds. The reverse side now features color photographs, bird descriptions and activity ideas that will get you excited about Missouri birds. Even if you have the original version, you'll want a new copy of this poster for all the additional information!



Conservation I Can Do

The newly released *Conservation I Can Do!* activity guide provides projects for young children that can be done in the comfort of home. Kids will have a blast creating forest and cave panoramas. Learn to make a homemade water viewer that aids in observing the watery world of fish, frogs and aquatic insects. Discover what owl pellets are, and then follow a recipe to make edible human replicas - yum! Kids will have hours of fun exploring this exciting and educational activity guide.



Butterfly Gardening:

Making your own butterfly garden is an educational way to attract butterflies. For an instructional booklet entitled *Butterfly Gardening and Conservation*, visit <http://www.conservation.state.mo.us/nathis/insects/butterf> or write to the address below.

To receive a copy of these publications, write to:
Distribution Center, Missouri Department of Conservation,
PO Box 180, Jefferson City, MO 65102.

MEDIA loan list

Birding for Beginners

High School-Adult/ 14 minute video
Birdwatching is a great way to enjoy the outdoors. The more you learn, the more you see. This video gives the basics of what to look for when you're trying to identify birds, including behavior, color, shape and sound.

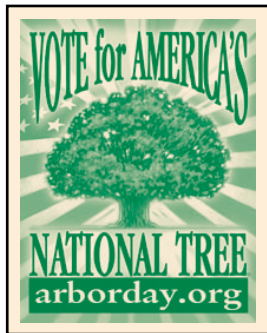
Butterflies

Elementary-Adult/ 10 minute video
Dynamic nature photography shows the fascinating changes butterflies undergo in a life cycle. Their feeding habits and use of camouflage are also explored.

You may borrow the following items by contacting our Media Librarian at (573)751-4115 x3837, fax at (573)751-2260 or writing to: Media Librarian, Missouri Department of Conservation, P.O. Box 180, Jefferson City, MO 65102-0180.

Vote for America's National Tree

Which tree would make the best symbol for America? Our trees are a vital part of our heritage and our future. Now you can join the American public in selecting a



single tree that best represents all of our beautiful trees, and our natural heritage. The final results of this historic vote will be announced on National Arbor Day, April 27, 2001.

Special classroom activities are available on the website. Visit <http://www.arborday.org> to place your vote!

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Mission Statement

The Resource is published in October, December, February and April by the Office of Environmental Education. Its purpose is to provide: current information on conservation and environmental education resources and events; suggestions for integrating environmental subjects into teaching; a forum for environmental education discussion and networking in Missouri; and a clearinghouse for bringing together environmental education resources and partners.

For a free subscription or to submit information to the newsletter, write to: Office of Environmental Education, Missouri Department of Conservation, P.O. Box 180 Jefferson City, MO 65102-0180.

Editors: Ginger Gray, Amy Linsenbardt and Kim Wade,
Missouri Department of Conservation
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OFFICE OF ENVIRONMENTAL EDUCATION

Missouri Department of Conservation

P.O. Box 180

Jefferson City, MO 65109-0180

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